

REMARKS

Claims 3, 7-12 and 14-26 are currently pending in this application. Claims 7-9 are independent claims.

Claims 3, 7-9, 11-12, 16-17, 19 and 22-24 stand rejected under 35 U.S.C. §103(a) as being obvious over Chakravorty (U.S. Patent No. 6,181,569) in combination with Honda et al. (U.S. Patent No. 6,181,569). The rejection is respectfully traversed.

In the Office Action, the Examiner point to Chakravorty as teaching a method of forming a plurality of metal bumps on a semiconductor similar to that of the present invention, but acknowledges that Chakravorty fails to disclose the steps recited in claim 1, lines 8-11, and claim 2, lines 15-22 (now incorporated into each of claims 7-9), namely, "placing a sheet of encapsulating material containing a thermosetting resin having a curing temperature over said semiconductor wafer so as to cover said main surface," and "heating and curing said sheet encapsulating material by a heating apparatus to thereby form an encapsulating resin layer."

The Examiner relies on the Honda reference to the cure the acknowledged deficiencies in Chakravorty. The Examiner asserts that Honda discloses a method of forming a laminating film for the semiconductor packaging devices which includes providing a BT substrate 1 or silicon chip 4 with metal bumps 3 (column 16, lines 40-42, and Figures 1-3), subsequently placing a sheet of encapsulating material 2 containing an epoxy resin with a curing agent and various additives such as flame retardants, having a curing temperature, over the main surface of substrate 1 or silicon chip 4 (column 12, lines 18-19, 30-32, column 16, lines 36-37, 58-60), then heating the sheet of encapsulating material to a temperature lower than the curing temperature of sheet encapsulating material to for a period of time and at a reduced pressure lower than atmospheric pressure (column 16, lines 28-29, 47-50 and 58-62), and subsequently increasing the temperature to the curing temperature or higher of the sheet encapsulating material 2 (column 16, lines 42-45, 53-56, 64-67).

The Examiner argues that it would have been within the scope to one of ordinary skill in the art to combine the teachings of Chakravorty with Honda because it would enable formation of encapsulant layer 312 of Chakravorty to be performed and obtain further advantage of having a semiconductor device of improved heat resistance,

moisture resistance, low stress property and minimize void content (Honda, column 3, lines 5-18).

While it may be true that Honda generally discloses a laminating film intended for use with semiconductor chips, it is respectfully submitted that the Examiner has picked this particular feature from the prior art without consideration of what the Honda reference teaches as a whole. Honda discloses an epoxy resin composition film 2 that is placed between a substrate 1 and a semiconductor chip 4 to act as a bonding and under-fill medium in the process of mounting the chip to the substrate (Honda Figures 1-3, column 12, lines 61-63). By contrast, in the method recited in the present claims, a sheet of encapsulating material is placed over the main surface of a semiconductor wafer, then heated and cured to form an encapsulating resin layer, after which the wafer is polished and divided into individual semiconductor devices. The processes are significantly different, and there is nothing in Honda to suggest that the epoxy resin film with a composition as disclosed would work in the present invention. Honda says nothing, for example, about the ability of the disclosed epoxy resin composition film to be polished after curing, as would be required by claims 7-9.

Further, it is respectfully submitted that Honda, like Chakravorty, fails to disclose the claimed method for eliminating voids in the cured encapsulating material. Claim 8, for example, recites that "said heating and curing are done in such a manner that the heating of said sheet encapsulating material is at a heating temperature lower than the curing temperature of said sheet encapsulating material, at which the viscosity of said sheet encapsulated material is low and voids contained in said sheet encapsulating material can escape, and said sheet encapsulating material is kept at said heating temperature and at a reduced pressure lower than atmospheric pressure for a period of time determined to be sufficient for said voids to be eliminated, and thereafter said sheet encapsulating material is increased in temperature to said curing temperature or higher."

As noted above, the Examiner relies on the fabrication procedures discussed at Honda column 16, lines 35-67, as disclosing the above quoted limitation. The applicant disagrees. What each of the procedures discloses is that the epoxy resin composition film 2 was placed on the substrate 1, "moderately pressed thereto at 80°C. and 0.1

kgf/cm² for 5 seconds, and preheated at 120°C. for 10 seconds.” But this is done before the chip is positioned on the film, so it is apparent that the preheating has nothing to do with eliminating voids from the surface of the semiconductor chip.

Similarly, the Examiner has misinterpreted the moderate pressure applied to the film during preheating to be a “a reduced pressure lower than atmospheric pressure,” as required by claim 8. It seems more reasonable that Honda is teaching the use of a slight additional pressure during preheating to encourage the film to stick to the substrate.

In the claimed invention, voids are eliminated by heating the sheet encapsulating material at a temperature lower than the curing temperature, at which the viscosity of the sheet encapsulating material is low and voids in the sheet encapsulating material can escape. A partial vacuum may be used to encourage the voids to leaving the encapsulating material. Honda deals with eliminating voids in a completely different manner, thus teaching away from the claimed invention. In Honda, the epoxy resin composition film includes a thermoplastic resin, avoiding the problem that when a semiconductor chip is sealed with a resin film of the specified composition, the film will lose its original shape or entrapped voids will be formed near the chip (see Abstract).

Regarding claimed 9, Examiner asserts that “it would have been within the scope to one of ordinary skill in the art to change the pressure to a sufficient amount that would be insufficient to materially alter the disclosed process which is encompassed by the claim. This argument is not understood. Nevertheless, it is clear from the foregoing that Honda fails to teach or suggest the application of a reduced pressure, less than atmospheric pressure, for removing voids, as in claim 8, or cycling between two different pressures, both less than atmospheric pressure, as in claim 9.

Accordingly, is respectfully submitted that independent claims 7-9, as well as dependent claims 3, 11, 12, 16, 17, 19 and 22-24, are patentably distinguishable over the applied prior art references, whether considered individually or in combination.

Claims 10 and 18 stand rejected under 35 USC §103(a) as being obvious over Chakravorty in combination with Honda, as applied to claims 3, 7-9, 11-12, 16-17, 19 and 22-24, and further in view of Teranuma et al., (U.S. Patent No. 6,392,217). Claims 14, 20 and 25 stand rejected under 35 USC §103(a) as being obvious over the base


combination of Chakravorty and Honda, as applied to claims 3, 7-9, 11-12, 16-17, 19 and 22-24, and further in view of Tsukagoshi et al., (U.S. Patent No. 6,113,728). Claims 15, 21 and 26 stand rejected under 35 USC §103(a) as being obvious over the base combination, as applied to claims 3, 7-9, 11-12, 16-17, 19 and 22-24, and further in view of Komiyatani et al., (U.S. Patent No. 6,447,915). It is respectfully submitted that claims 10, 14-15, 18, 20-21 and 25-26 patentably distinguish over the applied art combinations for at least the reasons discussed above in regard to their respective base claims.

In view of the foregoing, it is respectfully requested that the rejections of the pending claims be reconsidered and withdrawn. Such action and the passing of this case to issue are earnestly solicited.

Should the Examiner feel that a conference would help to expedite the prosecution of this application, the Examiner is hereby invited to contact the undersigned counsel to arrange for such an interview.

Respectfully submitted,

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Date


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